

CLAIMS

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1. A torque-limit signal cap for a filler neck, the cap comprising a handle rotatable about an axis of rotation, a closure adapted to close the filler neck, and a torque-limit signaler coupled to the handle and the closure and configured to disable temporarily transmission of torque about the axis of rotation in a cap-advancing direction from the handle to the closure during rotation of the handle about the axis of rotation in the cap-advancing direction to signal a person rotating the handle that the closure is seated in a filler neck-closing position, the torque-limit signaler comprising
 - a first drive receiver coupled to the closure for movement relative to the closure between a driver-engaged position and a driver-disengaged position,
 - a driver coupled to the handle to rotate therewith and contact the first driver receiver in the driver-engaged position during rotation of the handle about the axis of rotation in the cap-advancing direction to cause the closure to rotate about the axis of rotation, the driver being configured to urge the first drive receiver from the driver-engaged position to the driver-disengaged position to allow limited lost-motion rotation of the handle relative to the closure once torque in excess of a predetermined amount is applied to the handle about the axis of rotation during continued rotation of the handle about the axis of rotation in the cap-advancing direction, and
 - a second drive receiver coupled to the closure and located to contact the driver while the first drive receiver is maintained in the driver-disengaged position and after limited lost-motion rotation of the handle relative to the closure about the axis of rotation in the cap-advancing direction to produce a torque-limit signal indicating to a person rotating the handle about the axis of rotation in the cap-advancing direction that such limited lost-motion rotation of the handle relative to the closure about the axis of rotation has occurred and sufficient torque has been applied to the handle about the axis of rotation in the cap-advancing direction during installation of the closure in a filler neck to seat the closure in a filler neck-closing position in the filler neck.

2. The cap of claim 1, wherein the closure includes a closure base adapted to mate with the filler neck and a torque-transmission member positioned to

lie between the handle and the closure base and rotate about the axis of rotation and the first drive receiver is coupled to the torque-transmission member to rotate therewith.

3. The cap of claim 2, wherein the first drive receiver includes a
5 spring arm coupled at one end to the torque-transmission member and provided with a spring head at an opposite end that is arranged to maintain contact with the driver to provide a torque-limited connection during rotation of the handle about the axis of rotation in the cap-advancing direction.

4. The cap of claim 3, wherein the torque-transmission member is
10 formed to include an interior edge defining a lost-motion signal slot, the spring arm is coupled to the interior edge to position the spring head for movement in the lost-motion signal slot as the first drive receiver is moved between the driver-engaged position and the driver-disengaged position, one portion of the interior edge defines the second drive receiver and another portion of the interior edge provides a third
15 driver receiver arranged to contact the driver during rotation of the handle about the axis of rotation in a cap-removal direction that is opposite to the cap-advancing direction to provide a direct-drive connection in the cap-removal direction.

5. The cap of claim 3, wherein the driver includes separate first and second drive surfaces, the first drive surface is arranged to engage the spring head
20 when the first drive receiver lies in the driver-engaged position, and the second drive surface is arranged to engage the second drive receiver following movement of the first drive receiver to the driver-disengaged position and limited lost-motion rotation of the handle relative to the closure.

6. The cap of claim 2, wherein the torque-transmission member is
25 formed to include the second drive receiver.

7. The cap of claim 6, wherein the torque-transmission member is formed to include a lost-motion signal slot containing the first drive receiver therein and an interior edge defining a boundary of the lost-motion signal slot and providing the second drive receiver.

30 8. The cap of claim 6, wherein the torque-transmission member is formed to include a lost-motion signal slot containing the first drive receiver therein and an interior edge defining a boundary of the lost-motion signal slot and providing a third drive receiver arranged to contact the driver during rotation of the handle about

the axis of rotation in a cap-removal direction that is opposite to the cap-advancing direction to provide a direct-drive connection in the cap-removal direction.

9. The cap of claim 2, wherein the torque-transmission member is formed to include an arcuate lost-motion drive slot and a lost-motion signal slot, the closure base includes a driven post positioned for movement in the arcuate lost-motion drive slot, and the driver is positioned to move in the lost-motion signal slot during rotation of the handle about the axis of rotation upon movement of the first drive receiver to the driver disengaged position.

10. The cap of claim 9, wherein the first drive receiver includes a spring arm coupled at one end to the torque-transmission member and provided with a spring head at an opposite end that is arranged to maintain contact with the driver to provide a torque-limited connection during rotation of the handle about the axis of rotation in the cap-advancing direction.

11. The cap of claim 9, wherein the torque-transmission member is formed to include the second drive receiver.

12. The cap of claim 2, further comprising a rotary spring coupled to the handle and to the torque-transmission member.

13. The cap of claim 12, further comprising a rotary spring coupled to the torque-transmission member and to the closure base.

14. The cap of claim 2, further comprising a lost-motion driver comprising a first arcuate lost-motion drive slot formed in the torque-transmission member and a first driven post mounted on the closure base and arranged to extend into the first arcuate lost-motion drive slot and move therein along an arc length thereof during rotation of the torque-transmission member about the axis of rotation relative to the closure base.

15. The cap of claim 14, further comprising a rotary spring coupled at one end to the torque-transmission member and at another end to the closure base.

16. The cap of claim 1, further comprising a rotary spring coupled to the handle and to the closure.

17. The cap of claim 16, wherein the torsion spring is biased yieldably to urge the handle to rotate through a predetermined acute angle relative to the closure whenever a person rotating the handle in a cap-advancing direction releases the handle during cap installation after receiving the torque-limit signal.

18. The cap of claim 17, wherein the predetermined acute angle is about 15°.

19. A torque-limit signal cap for a filler neck, the cap comprising a handle rotatable about an axis of rotation, a closure adapted to close the filler neck, and signal means for producing limited lost-motion movement of the handle relative to the closure through a predetermined acute angle during rotation of handle in a cap-advancing direction about the axis of rotation following an initial rotation of handle and closure together as a unit in the cap-advancing direction about the axis of rotation to provide a limited lost-motion signal to a user rotating the handle during installation of a cap in a filler neck to indicate that sufficient torque has been applied to the handle during installation of the closure in a filler neck to seat the closure in a filler neck-closing position in the filler neck, wherein the signal means includes a driver coupled to the handle, a movable drive receiver coupled to the closure for movement between a driver-engaged position and a driver-disengaged position, and a fixed drive receiver coupled to the closure and located to engage the driver upon movement of the movable drive receiver to the driver-disengaged position.

20. The cap of claim 19, wherein the closure is formed to include a lost-motion signal slot containing the movable driver receiver therein and an interior edge defining a boundary of the lost-motion signal slot and providing the fixed drive receiver.

21. The cap of claim 20, wherein the movable drive receiver includes a spring arm coupled at one end to the closure and provided with a spring head at an opposite end that is arranged to maintain contact with the driver to provide a torque-limited connection during rotation of the handle about the axis of rotation in the cap-advancing direction, the handle includes a ceiling positioned to overlie the closure, and the driver is coupled to the ceiling to lie above the closure and contact the spring head during rotation of the handle about the axis of rotation.

22. The cap of claim 21, wherein the closure is formed to include a lost-motion signal slot containing the driver and the movable drive receiver therein and the closure is also formed to include an interior edge defining a boundary of the lost-motion signal slot and providing the fixed drive receiver.

23. A torque-limit signal cap for a filler neck, the cap comprising a handle rotatable about an axis of rotation, a closure adapted to close the filler neck, and signal means for producing limited lost-motion movement of the handle

5 relative to the closure through a predetermined acute angle during rotation of handle in a cap-advancing direction about the axis of rotation following an initial rotation of handle and closure together as a unit in the cap-advancing direction about the axis of rotation to provide a limited lost-motion signal to a user rotating the handle during installation of a cap in a filler neck to indicate that sufficient torque has been applied to

10 the handle during installation of the closure in a filler neck to seat the closure in a filler neck-closing position in the filler neck, wherein the closure includes a closure base adapted to mate with the filler neck and a torque-transmission member positioned to lie between the handle and the closure base, the signal means includes a driver coupled to the handle and a movable drive receiver coupled to the torque-transmission member,

15 and further comprising a rotary spring coupled to the handle and to the torque-transmission member and biased yieldably to urge the handle to rotate through a predetermined acute angle relative to the closure whenever a person rotating the handle in a cap-advancing direction releases the handle during cap installation after receiving the limited lost-motion signal.

20 24. The cap of claim 23, further comprising a lost-motion driver comprising a first arcuate lost-motion drive slot formed in the torque-transmission member and a first driven post mounted on the closure base and arranged to extend into the first arcuate lost-motion drive slot and move therein along an arc length thereof during rotation of the torque-transmission member about the axis of rotation relative to the closure base.

25 25. The cap of claim 24, further comprising a rotary spring coupled at one end to the torque-transmission member and at another end to the closure base.

26. A torque-limit signal cap for a filler neck, the cap comprising a handle rotatable about an axis of rotation,

30 a closure adapted to close the filler neck, and a torque-limit signaler coupled to the handle and to the closure and configured to provide means for temporarily interrupting a driving connection established between the handle and the closure to cause the handle to rotate through a

predetermined acute angle about the axis of rotation relative to the handle once torque in excess of a predetermined amount is applied to the handle about the axis of rotation in a cap-advancing direction to provide a limited lost-motion signal to a user rotating the handle during installation of a cap in a filler neck to indicate that sufficient torque

5 has been applied to the handle during installation of the closure in a filler neck to seat the closure in a filler neck-closing position in the filler neck and for reestablishing the driving connection between the handle and the closure after the handle has been rotated through the predetermined acute angle to discontinue provision of the limited lost-motion signal to the user.

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